Turf Management Effect on Annual Broadleaf Weed Invasion and Field Bindweed Management in Kentucky Bluegrass Turf

Final Report

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Introduction-

For two years previous to the initiation of this study, we followed the encroachment of white clover in a Kentucky bluegrass seeded turf at the University of Idaho Kimberly Research and Extension Center (KREC) with funding provided by the Idaho Nursery and Landscape Association. The results of this study were so intriguing we continued monitoring white clover invasion for an additional year. The original funding for this project was used to establish a lawn area with a designed irrigation system that enables us to have three irrigation regimes. As the turf study progressed, we concluded that we should continue on with more weed ecology in turf research as it relates to weed management. In the summer 2013, as we continued monitoring white clover establishment in the grass as it has become a mature stand, we also began to see the establishment of some common weeds such as common dandelion (*Taraxacum officinale* G.H. Weber ex Wiggers), and black medic (*Medicago lupulina* L.). These three weeds are common broadleaf weeds that infest turf. In addition to this site, we have a much more mature lawn area at KREC that is uniformly infested with the noxious perennial- field bindweed or morningglory (*Convolvulus arvensis* L.). Both of these sites provided us with the opportunity to continue exploring the effect of nitrogen management and irrigation level on weed encroachment and management.

The objectives of these studies were to:

1. Evaluate irrigation rate and nitrogen rate effects on dandelion and annual broadleaf weed encroachment and persistence in a turfgrass stand.
2. Evaluate field bindweed management with combinations of fertilizer rates and quinclorac herbicide.
3. Demonstrate to lawn care professionals and the general public proper irrigation and fertilization management methods for turfgrass in the Magic Valley of Idaho during biennial twilight tours and other university sponsored field days, educational seminars, and visits by horticulture students from the College of Southern Idaho and the University of Idaho.
4. Publish results in Weed Science, HortScience or Crop Science.
5. Prepare University of Idaho bulletin on integrated weed management methods for lawn maintenance.

To complete these objectives, the following methodology was employed

1. The study associated with objective 1 used the same fertilizer rate and slightly modified irrigation rate.
    a. Three irrigation regimes were arranged as main plots in a split block randomized complete block design with three replications. This required 9 independently controlled irrigation zones. Irrigation regimes were: 70, 100, and 130% ET replacement, using ET data from an Agrimet weather station located ¼ mile away.
    b. Four N fertility regimes were arranged as subplots within the irrigation treatments. Fertilization regimes were: 0, 2, 4 and 6 lb N/1000 ft^2. Applications were made in early spring, early summer, late summer and early fall with total seasonal amounts divided into four equal applications. Fertilization regimes were continued from applications that began in fall 2011.
    c. Weed seed of dandelion, prostrate knotweed, and black medic were uniformly distributed over the study site to ensure a potential for weed establishment in each treatment.
    d. Weed seedling emergence will be monitored with monthly counts taken in each plot.

2. The study associated with objective 2 was established on another lawn with a uniform infestation of field bindweed, Canada thistle, common dandelion and black medic within the study area.
    a. Four N fertility regimes were arranged as main plots in a split plot design with three replications. The fertilizer rates were: 0, 2, 4, 6, and 8 lb N/1000 ft^2. Applications were made in early spring, early summer, late summer and early fall with total seasonal amounts divided into four equal applications.
    b. Quinclorac + 2,4-D + dicamba + sulfentrazone (sold as Q4 by PBI Gordon) was applied at 7.5 pt/A as a subplot treatment. The subplot treatments were no herbicide and with herbicide.
    c. Plots will be evaluated for turf quality (1-9 scale). Weed control was measured monthly beginning in spring 2014.
    d. A visual weed control evaluation using the 0 N rate and no herbicide treatment as the untreated control.
3. Showcase research at field days, tours, master gardener training, etc.

Results and Discussion

Irrigation and fertilizer rate study. In the irrigation rate and fertilizer rate study, white clover was influenced only on one counting date by irrigation rate (Table 1). White clover density was higher in the 70% ET irrigation treatment on July 14. There was a trend for more white clover in the lowest irrigation rate on several other counting dates. When the turfgrass was not fertilized or under-fertilized, white clover populations were higher than where the turfgrass received 4 or 6 lb N/1000 ft^2 (Table 2). White clover density was consistently lowest in the highest fertilizer rate (6 lb N/1000 ft^2) throughout the year. White clover density averaged 59 stems/ft^2 over the seven counting dates with the highest rate. During this same period, white clover density in the 0 lb N/1000 ft^2 treatment averaged over 165 stems/ft^2.

Common dandelion density was influenced by irrigation rate and N rate at some of the measuring dates (Tables 3 and 4). When there was a significant difference in response to irrigation level, the highest populations were in highest irrigation rate (130% ET). However, this was not consistent throughout the growing season. In response to N rate, dandelion density was highest at the end of the growing season in the 0 N rate.

Field bindweed did not respond to N or irrigation rate (Tables 5 and 6).

Black medic density was influenced by an irrigation and fertilizer rate interaction on the June 25 counting date (Table 7). On that date, there was more black medic in the 130% ET and 0 N rate than any other treatment interaction. At 100% ET, there was slightly more black medic in the highest N rate compared to the lowest N rate. Neither irrigation rate nor N rate influenced black medic density at any of the remaining counting dates. We had expected to see a similar response as the white clover since both species are in the *Fabaceae* family. However, the more single tap root growth of the black medic may have influenced this response since white clover has a shallow and more fibrous or branching secondary root system.

There was a significant irrigation rate by N rate interaction at the August 15 counting date, but at all other counting dates the differences were in response to the main effects individually, if there

was a difference (Table 8). At the beginning of the season (April 15), turf color was lower in the 70% ET irrigation than the 100 or 130% ET treatments. This reflects on the soil moisture influence from the previous summer irrigation since the turf had not yet been watered in 2015. There also was a lower color rating in the 0 and 2 lb N rates compared to the 6 lb N rate. This difference remained consistent through the entire growing season, although at the October 15 evaluation date, only the 0 N rate was different from the highest N rate.

There was a significant irrigation rate by N rate interaction for turf quality three times during the growing season (Table 9). The interactions were significant at the May 15, June 15 and September 15 evaluation dates. Turf quality was significantly better with the highest N rate compared to the lowest N rate in each of the ET treatments. At 100% ET, turf quality was not as drastically different between the N rates as it was with the 70 or 130% ET rate, which would lead to the conclusion that under or over-watering turf can affect turf quality in response to soil N levels more than if the turf is being irrigated properly. At the April 15, July 15, August 15 and October 15 evaluation dates, the turf quality response was to the ET and N rate main effects. Turf quality was reduced in the 70% ET treatment compared to the 100 and 130% ET treatments in August and October. Turf quality responded to N rates at all of the evaluation dates. At many of the evaluation dates, the 0 and 2 lb N rates had lower quality ratings compared to the 4 and 6 lb N rates. In August however, there was a significant difference in turf quality between each N rate.

Field bindweed response to herbicide and fertilizer rates. The second study was established in an existing older turf site located at the UI Kimberly Research and Extension Center. Due to the complexity and diversity of weed species in this study, which includes field bindweed, Canada thistle, common dandelion, black medic and a few minor weeds, the herbicide was changed from quinclorac (Drive) to Q4 Plus for 2015. This herbicide is a combination of quinclorac (8.43%), sulfentrazone (0.69%), 2,4-D (11.81%) and dicamba (1.49%) and was applied at 7.5 fl oz/A. The N fertilizer rates were 0, 2, 4, 6, and 8 lb N/1000 ft^2.

The only statistical differences in field bindweed stem numbers were observed at the April (first) counting date, where the no herbicide plots averaged 84 stems/yd^2 compared to 0 stems/yd^2 in the Q4 Plus treated plots (Table 10). Unfortunately, this was the only month where there was a statistical difference in field bindweed stem numbers. This was due to the variability of the bindweed population in the study site. There continued to be numerical differences through most of the summer, but these were not significantly different. In response to N, the highest N rate had more stems per plot in April than where no fertilizer was applied. After that, there were no differences in stem counts in response to herbicide application or fertilizer rate.

Canada thistle averaged 12 stems/yd^2 in the Q4 Plus treated plots compared to 26 stems/yd^2 in the untreated plots at the April count (Table 10). However, there were no differences in Canada thistle density in the succeeding six months.

Common dandelion did respond to the herbicide application in April, May and June (Table 10). Fewer plants were counted in the herbicide-treated plots (average <1 plant/ft^2) compared to no herbicide (average 6 plants/ft^2). However, from July through August there were no differences in dandelion densities between herbicide and no herbicide treated plots. Only in August was there a

significant reduction in dandelion density between the 4, 6, and 8 lb N treatments and the no fertilizer treatment. The no fertilizer treatment averaged 14 plants/ft^2 and the 4, 6 and 8 lb N/1000 ft^2 fertilizer treatments averaged 4 plants/ft^2.

Black medic density did not respond to fertilizer treatment, but was significantly greater in the no herbicide plots (average 9 plants/ft^2) compared to the Q4 Plus treated plots (average <1 plant/ft^2) in April, May, June and July (Table 10). There were no differences in the August, September or October counts.

Turf color did not respond to herbicide application, but was better with the 6 and 8 lb N/1000 ft^2 rates compared to the 0, 2, or 4 lb N per 1000 ft^2 rates in April and May, but not the other three months.

Turf quality did respond favorable to herbicide application in all five months, and to higher fertilizer rates in April, May and July.

Results from this study so far show that the herbicide application is only effective in reducing field bindweed and Canada thistle densities early in the season, but does not control these two weeds as the summer begins. The herbicide does effectively reduce common dandelion and black medic densities through most of the season regardless of fertilizer rate. It appears that nitrogen fertilizer did not greatly enhance the turf competitiveness with the herbicide enough to improve weed control.

Table 1. White clover response to irrigation rate pooled across four nitrogen (N) rates[1].

	White clover						
Irrigation rate[2]	4/22	5/12	6/25	7/14	8/14	9/8	10/14
% ET	----------stems/ft^2----------						
130	121 a	73 a	114 a	114 b	66 a	72 a	47 a
100	118 a	94 a	111 a	96 b	72 a	67 a	50 a
70	198 a	150 a	232 a	184 a	143 a	140 a	92 a

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Evapotranspiration rates based off of Agrimet Weather station located approximately 0.33 mile from study site.

Table 2. White clover response to fertilizer rate pooled across three irrigation rates[1].

	White clover						
Nitrogen rate[2]	4/22	5/12	6/25	7/14	8/14	9/8	10/14
lb/1000ft^2	----------stems/ft^2----------						
0	219 a	172 a	208 a	217 a	134 a	120 a	84 a
2	178 ab	135 a	203 a	145 ab	117 a	104 a	80 a
4	113 bc	68 b	126 ab	92 b	76 a	87 a	47 a
6	73 c	47 b	73 b	71 b	47 a	62 a	41 a

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Fertilizer used was WilGro 31-3-7 manufactured by Wilbur Ellis Company.

Table 3. Common dandelion response to irrigation rate pooled across four nitrogen (N) rates[1].

	Common dandelion						
Irrigation rate[2]	4/22	5/12	6/25	7/14	8/14	9/8	10/14
% ET	----------plants/ft^2----------						
130	1.9 a	2.0 a	2.4 a	3.4 a	21.6 a	31.4 a	29.2 a
100	1.9 a	1.9 a	2.0 a	2.4 b	7.2 a	14.7 a	29.0 a
70	1.1 b	1.0 a	1.7 a	2.2 b	4.5 a	27.2 a	30.8 a

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Evapotranspiration rates based off of Agrimet Weather station located approximately 0.33 mile from study site.

Table 4. Common dandelion response to nitrogen fertilizer rate pooled across three irrigation rates[1].

	Common dandelion						
Nitrogen rate[2]	4/22	5/12	6/25	7/14	8/14	9/8	10/14
lb/1000ft^2	----------plants/ft^2----------						
0	2.7 a	2.5 a	2.2 a	3.4 a	32.2 a	42.6 a	79.4 a
2	1.6 b	1.6 b	2.9 a	2.8 a	5.6 a	30.1 a	14.1 b
4	1.3 b	1.3 b	1.9 a	1.7 a	3.6 a	13.8 a	12.1 b
6	1.0 b	1.3 b	1.7 a	2.6 a	3.1 a	11.3 a	13.3 b

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Fertilizer used was WilGro 31-3-7 manufactured by Wilbur Ellis Company.

Table 5. Field bindweed response to irrigation rate pooled across four nitrogen (N) rates[1].

	Field bindweed						
Irrigation rate[2]	4/22	5/12	6/25	7/14	8/14	9/8	10/14
% ET	----------stems/yd^2----------						
130	0.04 a	0.31 a	59 a	69 a	60 a	0.31 a	0.09 a
100	0.04 a	0.48 a	124 a	96 a	62 a	0.46 a	0.13 a
70	0.14 a	0.38 a	51 a	45 a	90 a	0.28 a	0.13 a

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Evapotranspiration rates based off of Agrimet Weather station located approximately 0.33 mile from study site.

Table 6. Field bindweed response to nitrogen fertilizer rate pooled across three irrigation rates[1].

	Field bindweed						
Nitrogen rate[2]	4/22	5/12	6/25	7/14	8/14	9/8	10/14
lb/1000ft^2	----------stems/yd^2----------						
0	0.00 a	0.23 a	48 a	61a	41a	0.29 a	0.08 a
2	0.02 a	0.24 a	57 a	54 a	59 a	0.34 a	0.08 a
4	0.03 a	0.26 a	73 a	78 a	83 a	0.41 a	0.12 a
6	0.23 a	0.82 a	133 a	87 a	99 a	0.37 a	0.18 a

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Fertilizer used was WilGro 31-3-7 manufactured by Wilbur Ellis Company.

Table 7. Black medic response to irrigation and nitrogen fertilizer rate[1]. There was a significant interaction response to irrigation rate and fertilizer rate at the June 25 counting date. At all other dates, the data are presented in response to the main effects- irrigation rate and fertilizer rate.

	Black medic						
		7/14		8/14		9/8	
ET/Nitrogen rate	6/25	ET	N Rate	ET	N Rate	ET	N Rate
	----------plants/yd2----------						
130% ET	-	0.37 a	-	0.24 a	-	0.17 a	-
0 lb N/1000ft^2	0.86 a	-	0.29 a	-	0.24 a	-	0.14 a
2 lb N/1000ft^2	0.18 cd	-	0.26 a	-	0.08 a	-	0.05 a
4 lb N/1000ft^2	0.12 cd	-	0.28 a	-	0.05 a	-	0.08 a
6 lb N/1000ft^2	0.38 bc	-	0.19 a	-	0.10 a	-	0.16 a
100% ET	-	0.22 a	-	0.10 a	-	0.14 a	-
0 lb N/1000ft^2	0.12 cd	-	-	-	-	-	-
2 lb N/1000ft^2	0.20 bcd	-	-	-	-	-	-
4 lb N/1000ft^2	0.20 bcd	-	-	-	-	-	-
6 lb N/1000ft^2	0.50 b	-	-	-	-	-	-
70% ET	-	0.18 a	-	0.03 a	-	0.01 a	-
0 lb N/1000ft^2	0.04 d	-	-	-	-	-	-
2 lb N/1000ft^2	0.24 bcd	-	-	-	-	-	-
4 lb N/1000ft^2	0.16 cd	-	-	-	-	-	-
6 lb N/1000ft^2	0.06 d	-	-	-	-	-	-

Table 8. Turf color in response to three irrigation and four nitrogen fertilizer rates[1]. There was a significant interaction response to irrigation rate and fertilizer rate at the September 15 evaluation date. At all other dates, the data are presented in response to the main effects- irrigation rate and fertilizer rate.

	Turf color[2]												
	4/15		5/15		6/15		7/15		8/15	9/15		10/15	
ET/Nitrogen rate[3]	ET[4]	N Rate	ET	N Rate	ET	N Rate	ET	N Rate	INT	ET	N Rate	ET	N Rate
	color rating												
130% ET	5.3 a	-	5.6 a	-	6.3 a		6.2 a	-	-	6.2 b	-	6.4 a	-
0 lb N/1000ft^2	-	3.9 c	-	4.2 c	-	5.6 c	-	5.4 b	6.0 c	-	5.6 c	-	5.3 b
2 lb N/1000ft^2	-	5.0 b	-	4.8 c	-	5.9 bc	-	5.8 b	6.0 c	-	5.8 c	-	6.1 a
4 lb N/1000ft^2	-	5.6 ab	-	5.7 b	-	6.3 ab	-	6.1 b	6.0 c	-	6.6 b	-	6.7 a
6 lb N/1000ft^2	-	5.9 a	-	6.6 a	-	6.7 a	-	6.9 a	6.7 b	-	7.0 a	-	6.7 a
100% ET	5.3 a	-	5.6 a	-	6.5 a	-	6.3 a	-	-	6.7 a	-	6.7 a	-
0 lb N/1000ft^2	-	-	-	-	-	-	-	-	6.0 c	-	-	-	-
2 lb N/1000ft^2	-	-	-	-	-	-	-	-	6.0 c	-	-	-	-
4 lb N/1000ft^2	-	-	-	-	-	-	-	-	7.0 b	-	-	-	-
6 lb N/1000ft^2	-	-	-	-	-	-	-	-	7.7 a	-	-	-	-
70% ET	4.7 b	-	4.8 a	-	5.5 a	-	5.7 a	-	-	5.8 b	-	5.5 a	-
0 lb N/1000ft^2	-	-	-	-	-	-	-	-	3.0 e	-	-	-	-
2 lb N/1000ft^2	-	-	-	-	-	-	-	-	3.7 d	-	-	-	-
4 lb N/1000ft^2	-	-	-	-	-	-	-	-	3.0 e	-	-	-	-
6 lb N/1000ft^2	-	-	-	-	-	-	-	-	3.3 de	-	-	-	-

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Turf color rating based on a 1 to 9 scale established by NTEP turfgrass evaluation guidelines.
[3]Fertilizer used was WilGro 31-3-7 manufactured by Wilbur Ellis Company.
[4]ET = response to evapotranspiration or irrigation rate. N rate = response to the nitrogen rate

Table 9. Turf quality in response to three irrigation and four nitrogen fertilizer rates[1]. There was a significant irrigation rate and fertilizer rate interaction at the May 15, June 15 and September 15 evaluation dates. At all other dates, the data are presented in response to the main effects- irrigation rate and fertilizer rate.

	Turf quality[2]										
	4/15		5/15	6/15	7/15		8/15		9/15	10/15	
ET/Nitrogen rate[3]	ET[4]	N Rate	INT	INT	ET	N Rate	ET	N Rate	INT	ET	N Rate
	quality rating										
130% ET	5.3 a	-	-	-	6.3 a	-	5.6 a	-	-	6.1 a	-
0 lb N/1000ft^2	-	3.9 c	4.3 cd	4.7 ef	-	4.6 b	-	4.0 d	4.3 ef	-	4.4 c
2 lb N/1000ft^2	-	4.3 bc	5.3 bc	5.3 de	-	5.2 b	-	4.6 c	5.0 de	-	5.6 b
4 lb N/1000ft^2	-	5.0 ab	5.7 b	5.7 cd	-	6.4 a	-	5.3 b	5.7 cd	-	6.7 a
6 lb N/1000ft^2	-	5.9 a	7.7 a	7.3 a	-	7.3 a	-	6.2 a	6.3 bc	-	6.9 a
100% ET	4.8 a	-	-	-	6.0 a	-	5.8 a	-	-	6.5 a	-
0 lb N/1000ft^2	-	-	4.7 bc	4.7 ef	-	-	-	-	4.3 ef	-	-
2 lb N/1000ft^2	-	-	4.7 bc	5.3 de	-	-	-	-	4.7 ef	-	-
4 lb N/1000ft^2	-	-	5.7 b	6.3 bc	-	-	-	-	6.7 b	-	-
6 lb N/1000ft^2	-	-	7.3 a	7.0 ab	-	-	-	-	7.7 a	-	-
70% ET	4.3 a	-	-	-	5.3 a	-	3.7 b	-	-	5.1 b	-
0 lb N/1000ft^2	-	-	3.3 d	4.0 f	-	-	-	-	4.0 f	-	-
2 lb N/1000ft^2	-	-	4.7 bc	4.7 ef	-	-	-	-	5.0 de	-	-
4 lb N/1000ft^2	-	-	5.7 b	5.3 de	-	-	-	-	4.7 ef	-	-
6 lb N/1000ft^2	-	-	5.0 bc	5.0 de	-	-	-	-	6.0 bc	-	-

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Turf quality rating based on a 1 to 9 scale established by NTEP turfgrass evaluation guidelines.
[3]Fertilizer used was WilGro 31-3-7 manufactured by Wilbur Ellis Company.
[4]ET = response to evapotranspiration or irrigation rate. N rate = response to the nitrogen rate

Table 10. Broadleaf weed response to a fall Q4 herbicide application pooled across nitrogen fertilizer treatments[1].

	Weed counts[2]													
	4/23		5/15		6/25		7/13		8/14		9/8		10/16	
Treatment	None	Herb	None	Herb	None	Herb	None	Herb	None	Herb	None	Herb	None	Herb
	plants/yd^2													
Field bindweed	84 a	0 b	56 a	23 a	86 a	60 a	143 a	121 a	187 a	97 a	165 a	223 a	66 a	74 a
Canada thistle	26 a	12 b	10 a	14 a	32 a	32 a	50 a	22 a	23 a	22 a	15 a	13 a	18 a	21 a
Common dandelion	22a	2 b	31 a	5 b	34 a	4 b	32 a	30 a	39 a	28 a	40 a	27 a	61 a	48 a
Black medic	33 a	0 b	73 a	4 b	28 a	3 b	26 a	4 b	17 a	6 a	14 a	18 a	17 a	16 a

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2] Weed counts. Field bindweed=shoots/yd^2. All other weeds= plants/yd^2. None = no herbicide applied. Herb = Q4 herbicide application.

Table 11. Turf color in response to N fertilizer rate and herbicide[1]. There was a significant fertilizer rate by herbicide interaction at the May 19 evaluation date. At all other dates, the data are presented in response to the main effects- fertilizer rate and the presence or absence of herbicide.

	Turf color[2]													
	4/24		5/19	6/25		7/17		8/14		9/11		10/16	
Treatment	Fert[3]	Herb	INT	Fert	Herb	Fert	Herb	Fert	Herb	Fert	Herb	Fert	Herb
	Color rating[2]												
No herbicide	-	5.5 a	-	-	6.5 a	-	6.1 a	-	5.9 a	-	6.2 a	-	6.1 a
0 lb N/1000 ft^2	3.7 d	-	5.0 f	6.2 a	-	5.5 a	-	5.2 a	-	5.7 b	-	4.0 c	-
2 lb N/1000 ft^2	5.0 c	-	5.7 e	6.3 a	-	6.0 a	-	5.7 a	-	6.0 b	-	5.8 b	-
4 lb N/1000 ft^2	5.8 bc	-	6.7 bc	7.0 a	-	6.3 a	-	6.0 a	-	6.3 ab	-	6.3 ab	-
6 lb N/1000 ft^2	6.5 ab	-	6.7 bc	7.0 a	-	6.2 a	-	6.0 a	-	6.8 a	-	6.7 ab	-
8 lb N/1000 ft^2	7.2 a	-	7.0 a	-	-	6.5 a	-	6.0 a	-	6.8 a	-	7.5 a	-
Q4 Plus	-	5.7 a	-	-	6.7 a	-	6.1 a	-	5.6 a	-	6.5 a	-	6.1 a
0 lb N/1000 ft^2	-	-	5.0 a	-	-	-	-	-	-	-	-	-	-
2 lb N/1000 ft^2	-	-	6.0 de	-	-	-	-	-	-	-	-	-	-
4 lb N/1000 ft^2	-	-	6.7 bc	-	-	-	-	-	-	-	-	-	-
6 lb N/1000 ft^2	-	-	7.0 ab		-	-	-	-	-	-	-	-	-
8 lb N/1000 ft^2	-	-	7.3 a	-	-	-	-	-	-	-	-	-	-

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Color rating based on a 1 to 9 scale established by NTEP turfgrass evaluation guidelines.
[3]Fert = nitrogen fertilizer treatment. Herb = no herbicide applied or herbicide applied.

Table 11. Turf quality in response to N fertilizer rate and herbicide[1]. There was a significant fertilizer rate by herbicide interaction at the July 17 and September 11 evaluation dates. At all other dates, the data are presented in response to the main effects- fertilizer rate and the presence or absence of herbicide.

	Turf quality[2]											
	4/24		5/19		6/25		7/17	8/14		9/11	10/16	
Treatment	Fert	Herb	Fert	Herb	Fert	Herb	INT	Fert	Herb	INT	Fert	Herb
	----------Quality ratings----------											
No herbicide	-	4.5 b	-	4.7 b	-	5.5 b	-	-	4.6 b	-	-	4.9 b
0 lb N/1000 ft^2	3.8 d	-	4.2 c	-	5.7 a	-	5.0 b	4.5 a	-	4.7 de	4.3 c	-
2 lb N/1000 ft^2	4.3 cd	-	5.0 bc	-	5.5 a	-	5.3 b	4.7 a	-	4.7 de	4.8 bc	-
4 lb N/1000 ft^2	5.0 bc	-	6.0 ab	-	6.0 a	-	5.3 b	5.0 a	-	4.3 e	5.7 ab	-
6 lb N/1000 ft^2	5.7 ab	-	6.5 a	-	6.7 a	-	5.7 b	6.0 a	-	5.0 cd	5.8 ab	-
8 lb N/1000 ft^2	6.2 a	-	6.2 ab	-	6.5 a	-	5.0 b	6.0 a	-	5.3 c	6.7 a	-
Q4 Plus	-	5.5 a	-	6.4 a	-	6.6 a	-	-	5.6 a	-	-	6.0 a
0 lb N/1000 ft^2	-	-	-	-	-	-	3.7 c	-	-	3.7 f	-	-
2 lb N/1000 ft^2	-	-	-	-	-	-	5.3 b	-	-	5.3 c	-	-
4 lb N/1000 ft^2	-	-	-	-	-	-	7.0 a	-	-	6.0 b	-	-
6 lb N/1000 ft^2	-	-	-	-	-	-	7.3 a	-	-	7.0 a	-	-
8 lb N/1000 ft^2	-	-	-	-	-	-	7.3 a	-	-	6.7 a	-	-

[1]Means followed by the same letter are not statistically different at the P>0.05 significance level.
[2]Quality rating based on a 1 to 9 scale established by NTEP turfgrass evaluation guidelines.
[3]Fert = nitrogen fertilizer treatment. Herb = no herbicide applied or herbicide applied.

Figure 1. 90% ET irrigation plot with four nitrogen fertilizer subplots. From left to right the nitrogen rates are 0, 2, 4, and 6 pounds of nitrogen per 1000 square feet.

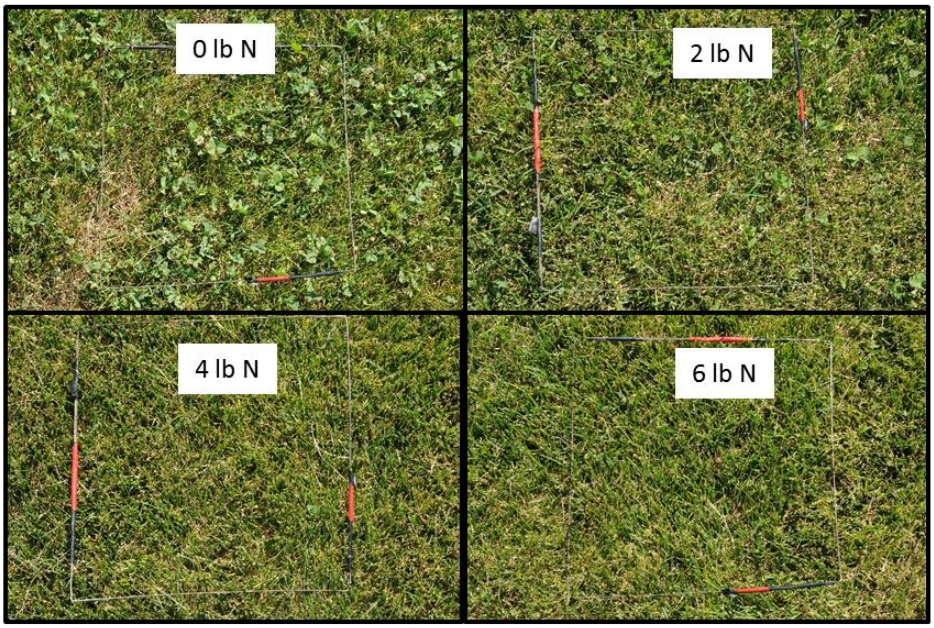

Figure 2. Closeup of nitrogen rates in each sub-plot

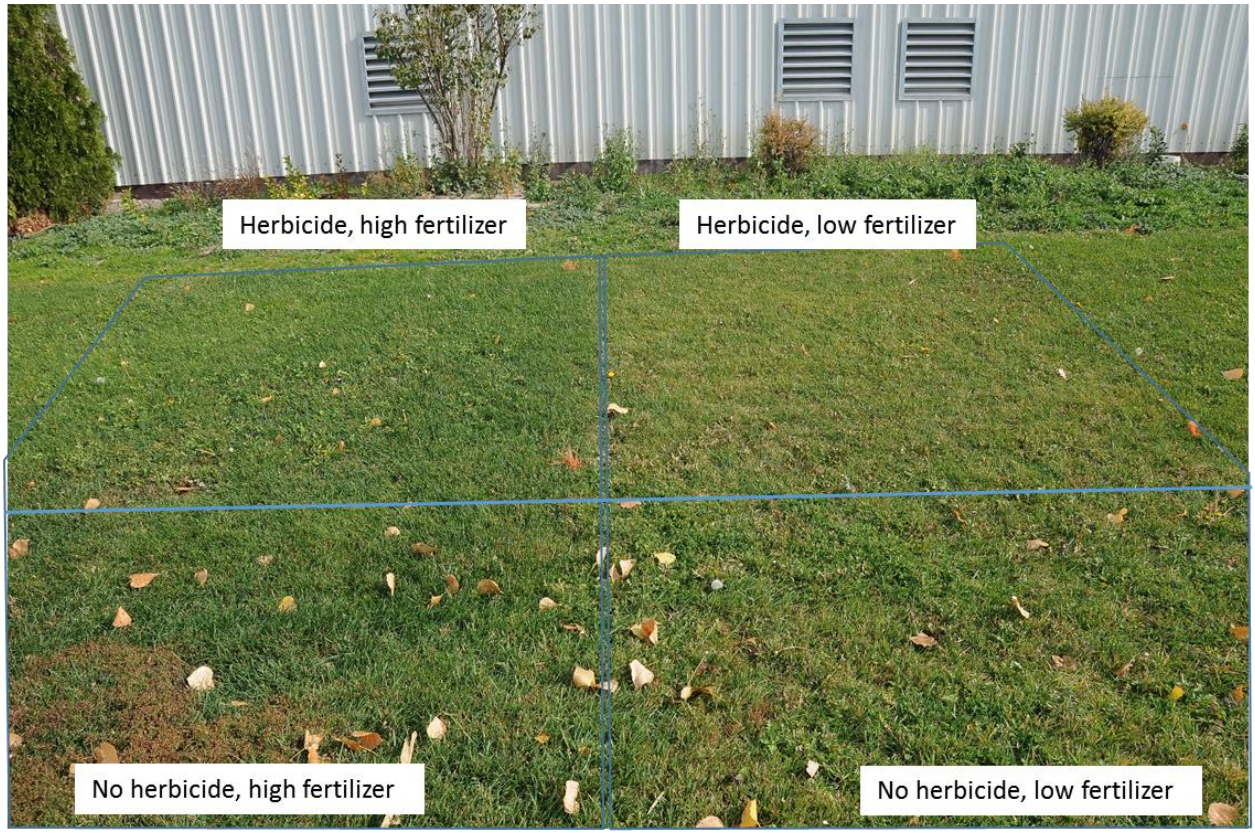

Figure 3. Layout of two split plots with fertilizer rate at the main plot and herbicide as the sub-plot